

ifm electronic



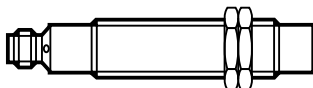
Original operating instructions
Fail-safe inductive sensor

efector100

GG505S

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701833 / 03 06 / 2010




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1 Preliminary note

The instructions are part of the unit. They are intended for authorised persons according to the EMC and Low Voltage Directive and safety regulations. The instructions contain information about the correct handling of the product. Read the instructions before use to familiarise yourself with operating conditions, installation and operation. Adhere to the safety instructions.

1.1 Explanation of symbols

- ▶ Request for action
- LED on
- LED off
- ☼ LED flashes
- ☼ LED flashes quickly
-  Important note

2 Safety instructions

- Follow the operating instructions.
- Improper use may result in malfunctions of the unit. This can lead to personal injury and/or damage to property during operation of the machine. For this reason note all remarks on installation and handling given in these instructions. Also adhere to the safety instructions for the operation of the whole installation.
- In case of non-observance of notes or standards, specially when tampering with and/or modifying the unit, any liability and warranty is excluded.
- The unit must be installed, connected and put into operation by a qualified electrician trained in safety technology.
- The applicable technical standards for the corresponding application must be complied with.
- For installation the requirements according to EN 60204 must be observed.
- In case of malfunction of the unit please contact the manufacturer. Tampering with the unit is not allowed.
- Disconnect the unit externally before handling it. Also disconnect any independently supplied relay load circuits.
- After setup the system has to be subjected to a complete function check.
- Only use the unit under the specified operating conditions (→ 11 Technical data). In case of special operating conditions please contact the manufacturer.
- Use only as described below (→ 4).

2.1 Safety-related requirements regarding the application

It must be ensured that the safety requirements of the respective application correspond to the requirements stated in these instructions.

Observe the following requirements:

- ▶ Take measures to avoid metallic objects being placed on the sensing face intentionally or unintentionally.
- ▶ Adhere to EN 1088 for interlocking devices associated with guards.
- ▶ Adhere to the specified operating conditions (→ 11 Technical data). Use of the sensor in the vicinity of chemical and biological media as well as ionising radiation is not permitted.

- ▶ Adhere to the principle of normally closed operation for all external safety circuits connected to the system.
- ▶ In case of faults within the fail-safe sensor which result in the defined safe state: take measures to maintain the safe state when the complete control system continues to be operated.
- ▶ Replace damaged units.

3 Items supplied

1 fail-safe sensor GG505S with 2 M18 mounting nuts,
1 operating instructions GG505S, ident no. 701833.

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If one of the above-mentioned components is missing or damaged, please contact one of the ifm branch offices.

4 Functions and features

The fail-safe inductive sensor detects metal without contact.

Safety function SF: the safe state (output stage switched off; logic "0") is achieved when undamping greater than or equal to the safe switch-off distance s_{ar} (→ 11 Technical data).

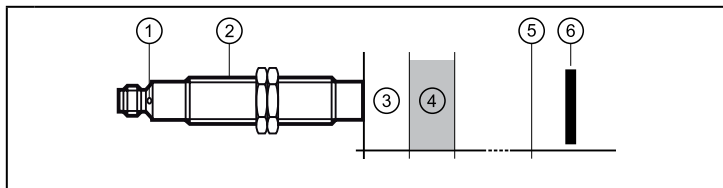
Also observe the notes on installation of the sensor (→ 6 Installation).

The fail-safe sensor conforms to the category 4 according to EN 954-1 (valid until 31 December 2011), Performance Level e according to EN ISO 13849-1:2008 as well as to the requirements SIL 3 to IEC 61508.

The unit corresponds to the classification I2A18SP2M to IEC 60947-5-2 for non-flush installation (→ 6 Installation).

The fail-safe inductive sensor has been certified by TÜVNord.

5 Function



① Dual LED: signal (yellow); power (green)

② Fail-safe sensor

③ Close range

④ Enable zone

⑤ Safe switch-off distance s_{ar}

⑥ Target

5.1 Enable zone

The output is only enabled when damped in the enable zone. Outside this enable zone the output remains switched off.

If damped with a standard target plate of 24 x 24 x 1 mm made of FE360 (= mild steel) and non-flush installation to IEC 60947-5-2 the enable zone is in the range of 3...6 mm.

The safe switch-off distance s_{ar} is > 15 mm.

The enable zone is different if damping elements which deviate from the standard target plate in terms of material, form and size are used.

Enable zone for other materials*:

Material	Enable zone
steel FE360	3...6 mm
stainless steel 1.4301/304S15	1.7...4.3 mm
AlMg3G22	0.5...2.2 mm
CuZn37	0.5...2.5 mm

* Typical values for damping with a reference target of 24 x 24 x 1 mm and non-flush installation to IEC 60947-5-2 at an ambient temperature of 20°C.

5.2 Protection against simple defeating

The fail-safe sensor reacts to metal objects, e.g. the frame of a security door. Other metal objects that are not intended to enable the sensor must not be allowed to enable the fail-safe sensor, either intentionally or unintentionally.

- i** ▶ Take measures to prevent metal objects, except the designated target, from being placed on the sensing face or in the enable zone intentionally or unintentionally.

In addition, the sensor has the following switching characteristics to make simple defeating of its safety function more difficult:

1. By slowly introducing a metallic object into the enable zone, the output is immediately switched, but displayed by the signal LED with a delay of about 3 s (→ 9.4.1 Delayed switching of the LED). By doing so, the object is generally in the close range before the LED indication is lit. The technical instructions concerning the restart of the installation must be observed.
2. If the object stays in the close range for longer than approx. 2 s, the output is completely disabled and no longer enabled if damped in the enable zone. If the object stays in the close range for longer than approx. 5 s, the adjustment mode is activated (→ 8.1 Activate adjustment mode).

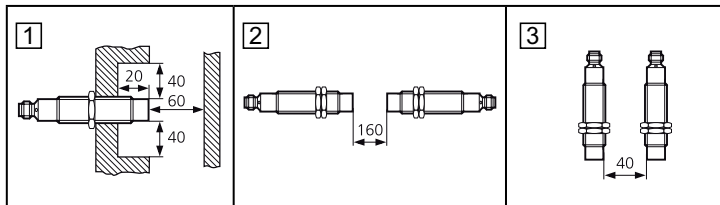
Release of the enable zone can be carried out

- either by undamping (> 15 mm) for a time of more than 2 s
- or by a voltage interruption (→ 8.3 End adjustment mode).

6 Installation

The unit is non-flush mountable according to IEC 60947-5-2, type I2A18SP2M.

- ▶ Ensure the unit cannot work loose. Maximum tightening torque: 40 Nm
- ▶ Adhere to the installation conditions in accordance with the figures 1 to 3:



- i** ► Install the unit non-flush only.
In case of flush installation, the sensing range is increased and the sensor can remain permanently switched (not allowed).

7 Electrical connection

Wiring diagram → 11 Technical data

- Disconnect the unit. Also disconnect any independently supplied relay load circuits.
- Supply voltage: connect L+ to pin 1 and L- to pin 3 of the connector.

i The nominal voltage is 24 V DC. This voltage may vary between 19.2 V and 30 V incl. 5% residual ripple to EN 61131-2.

i In case of one fault the supply voltage must not exceed 60 V DC for more than 0.2 s up to a max. value of 120 V DC (this corresponds to SELV to EN 60950-1).

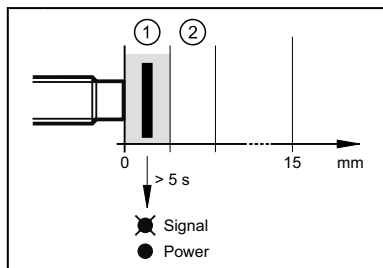
i For unit with cULus approval and the scope of validity cULus:
The device shall be supplied from an isolating transformer having a secondary listed fuse rated either

- max. 5 amps for voltages 0~20 Vrms (0~28.3 Vp) or
- 100/Vp for voltages of 20~30 Vrms (28.3~42.4 Vp).

8 Set-up

8.1 Activate adjustment mode

For easy and reliable installation the sensor can be put in the adjustment mode.



This is done by placing a metallic object directly in front of the sensing face of the fail-safe sensor (close range).

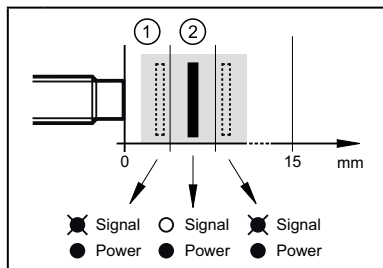
After approx. 5 s the yellow signal LED starts to flash: the adjustment mode is active.

As long as this mode is active, the output stage remains in the safe state ("0").

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8.2 Determine the enable zone

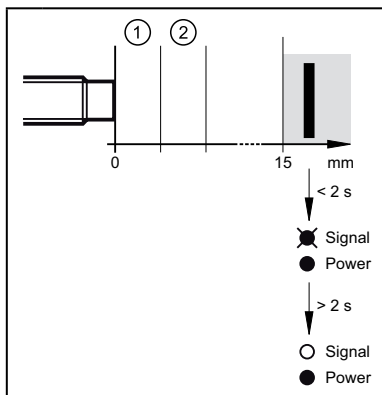
If the sensor is in the adjustment mode, the enable zone of the sensor can be determined by moving the damping element.



As soon as damping is carried out in the enable zone, the yellow LED goes out.

If the target is in the close range or in the immediate vicinity of the enable zone, the LED starts to flash again.

8.3 End adjustment mode



If the sensor is undamped for more than 2 s (> 15 mm), the adjustment mode is switched off and the yellow LED goes out.

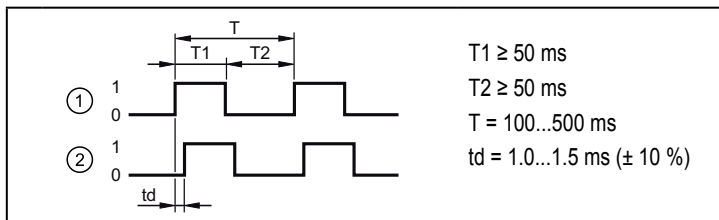
This can also be achieved by power off.

- ① Close range
- ② Enable zone

9 Operation

9.1 Sensor signals

The safe state is when the output is switched off (zero-current state: logic "0"). The fail-safe sensor must be operated with a clock signal on its clock input (TE). The clock input signal must meet the defined time conditions (see figure).



- ① Clock input (TE)
- ② Output

9.2 Input characteristics / output characteristics

The electrical input characteristics are compatible with the output characteristics to EN 61131-2 (nominal current 0.1 A and nominal voltage 24 V):

Logic "1"	$\geq 11 \text{ V}, < 30 \text{ V}$	Input current approx. 3 mA
Logic "0"	$\leq 5 \text{ V}$	Leakage current 500 μA
Permissible test pulse duration	$\leq 1.0 \text{ ms}$	

If the target is in the enable zone and there is no sensor fault, the clock input signal is transferred to the output with the delay t_d . The output characteristics are compatible with the input characteristics to EN 61131-2 type 1 or 2:

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Logic "1"	$\geq 15 \text{ V}$ $\geq 11 \text{ V}$	2...15 mA 15...30 mA Output impedance typ. 27 Ω
Logic "0"	$\leq 5 \text{ V}$	Leakage current 0 mA (pull-down current typ. 30 mA)

If the target is outside the enable zone, the output is switched off (logic "0").

i Non-observance of the time diagram (e.g. no time offset t_d ; permanently logic "1" \rightarrow 9.1) is a fault.

9.3 Cross faults

i Cross faults are detected by the fail-safe sensor and lead to an error message (permanently logic "1"). The pull-down current of the clock generator must not exceed 30 mA as the fail-safe sensor can no longer switch this current. An error message is no longer possible then.

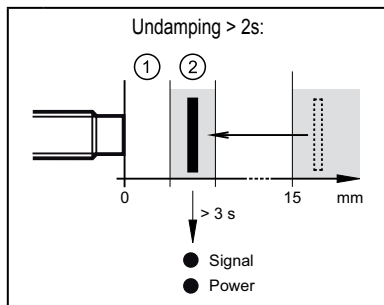
9.4 Operating mode

The length of the preceding undamping determines whether the yellow LED comes on with a delay (→ 9.4.1) or without delay (→ 9.4.2) when a target moves into the enable zone. In any case, the output switches on without delay.

In case of undamping the output switches off and the yellow LED goes out without delay.

In case of damping in the close range the output switches off immediately whereas the yellow LED goes out with a delay of approx. 2 s. With the deactivation of the LED the output is maintained in the safe state (logic "0"). Thus, switching on again in the enable zone is not possible. Enabling is done by undamping (> 15 mm) of more than 2 s or by interrupting the voltage (→ 5.2 Protection against simple defeating).

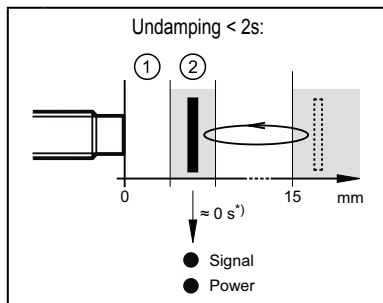
9.4.1 Delayed switching of the LED



If the target was away from the sensor for more than approx. 2 s (> 15 mm), the yellow LED goes on with a delay of approx. 3 s in case of damping in the enable zone.

This is also the case if the target is in the enable zone when the voltage is switched on.

9.4.2 Switching of the LED without delay



If the target was away from the sensor for less than 2 s (> 15 mm), the yellow LED comes on without delay in case of damping in the enable zone.

9.5 Response times

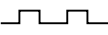
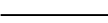
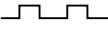
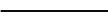
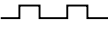
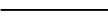

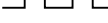
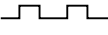

(Without response time of the monitoring unit)

Response time on safety request (removal from the enable zone)	$\leq 20 \text{ ms}$ ¹⁾
Response time when approaching the close range (non safety-related zone)	$\leq T$
Response time when approaching the enable zone (enable time):	typ. 100 ms $\leq 200 \text{ ms}$ ²⁾
Response time when switching off the clock input	$\leq 2 \text{ ms}$
Response time for enabling to rising edge of TE (damped in the enable zone)	typ. 40 ms max. 100 ms
Response time / risk time for safety-related faults	$\leq T$
Permissible dwell time in the close range	approx. 2 s
Time delay for activation of the adjustment mode (→ 8.1 Activate adjustment mode)	approx. 5 s
Dwell time in the undamped condition ($\geq 15 \text{ mm}$) to return into the operating mode (→ 8.3 End adjustment mode)	approx. 2 s

¹⁾ During this time the output is switched off (logic "0").

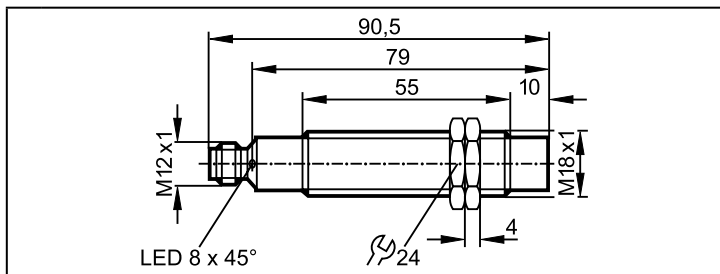
²⁾ As from this instant the clock input signal is transferred to the output with a delay.

9.6 LED display

	LED	Operating status	Sensor signals
○ ○	Signal Power	No voltage supply	
○ ⊗	Signal Power	Undervoltage	TE ₀ ¹  A ₀ ¹ 
○ ⊗	Signal Power	Overvoltage	TE ₀ ¹  A ₀ ¹ 
○ ●	Signal Power	Output switched off (safe state), target outside the enable zone (operating mode) or target in the enable zone (adjustment mode)	TE ₀ ¹  A ₀ ¹ 
● ●	Signal Power	Output switched, target in the enable zone (operating mode)	TE ₀ ¹  A ₀ ¹ 
⊗ ●	Signal Power	Output switched off (safe state), target outside the enable zone (adjustment mode)	TE ₀ ¹  A ₀ ¹ 
⊗ ○	Signal Power	Internal or external fault (→ 12 Troubleshooting)	

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10 Scale drawing



① Dual LED: signal (yellow); power (green)

11 Technical data

GG505S

GIGA-4015-US

Fail-safe inductive sensor

Metal thread M18 x 1

M12 connector

Enable zone: 3...6 mm

non-flush mountable

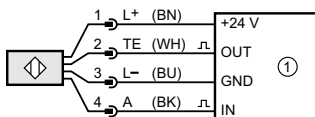
Conforms to the requirements of:

SIL 3 to IEC 61508:2000, EN ISO 13849-1:2008 category 4 PL e

Operating voltage	24 V DC (19.2...30 V)
Short-circuit protection	yes
Reverse polarity protection	yes
Current consumption	< 15 mA
Response time	Response time on safety request (removal from the enable zone): ≤ 20 ms Response time when approaching the enable zone (enable time), typ. 100 ms, ≤ 200 ms

Power-on delay time	5 s
Safe switch-off distance s_{gr}	15 mm
Operating mode	continuous operation (maintenance-free)
EMC / vibration, shock	according to IEC 60947-5-2
Application	Class C to EN 60654-1 (weatherproof application)
Climate	
Ambient temperature	-25...70 °C*) 10...40 °C **)
Relative air humidity	5...95 % *) 5...70 % **)
Rate of temperature change	0.5 K/min
Air pressure	80...106 kPa
Mission time T_M (mission time)	max. 87 600 h (10 years) *) max. 175 200 h (20 years) **)
Safety-related reliability PFH (PFH_D)	$1.1 \times 10^{-9}/h$
MTTF _D	> 2 500 years
DC / CCF / Cat.	99 % / 65 % / 4
Protection	IP 68 / IP 69K (to EN 60529), III
Housing materials	PBT, high-grade stainless steel
Display	LED yellow (signal); LED green (power)
Connection	M12 connector, gold-plated contacts

Wiring diagram



① safety relay or PLC to EN 61131-2

Core colours:

BK: black

BN: brown

BU: blue

WH: white

The core colours (BN, BK, BU, WH) apply to the use of ifm sockets.

Comments:

*) Mission time $T_M = 10$ years

**) Mission time $T_M = 20$ years

- Unless stated otherwise, all data refer to the 24 x 24 x 1 mm reference target plate to IEC 60947-5-2 (FE360 = mild steel) over the whole temperature range.

12 Troubleshooting

LED display → 9.6

Problem	Possible cause	Troubleshooting
No LED display	No voltage supply	Apply voltage
Power LED flashes and sensor does not switch	• Undervoltage • Overvoltage	Correct the voltage (→ 11 Technical data)
The Power LED is off and the signal LED flashes	Internal or external fault	• Undamp / damp • Power off / on • Replace the unit • Check wiring / connections • Check external electronics (e.g. G150xS or PLC)

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13 Maintenance, repair and disposal

If used correctly no maintenance and repair measures are necessary.

Only the manufacturer is allowed to repair the unit.

After use dispose of the unit in an environmentally friendly way in accordance with the applicable national regulations.

14 Approvals / standards

The following standards and directives have been applied:

- 2006/42/EC European Machinery Directive
- 2004/108/EC EMC Directive
- DIN EN 954-1 (1996) category 4, safety of machinery, safety-related parts of control systems (valid until 31 December 2011)
- EN ISO 13849-1: 2008 PL e, safety of machinery, safety-related parts of control systems
- IEC 60947-5-2 (2008) low-voltage switchgear: control circuit devices and switching elements - proximity switches
- IEC 61508 (2000)
- UL 508

15 Terms and abbreviations

Cat.	Category	Classification of the safety-related parts of a controller as regards their resistance to failures.
CCF	Common Cause Failure	
DC	Diagnostic Coverage	
MTTF _D	Mean Time To Dangerous Failure	
PFH (PFH _D)	Probability of (dangerous) Failure per Hour	
PL	Performance Level	PL to EN ISO 13849-1
SIL	Safety Integrity Level	SIL 1-4 to IEC 61508
PLC		Programmable Logic Controller
T _M	Mission Time	= maximum service life

